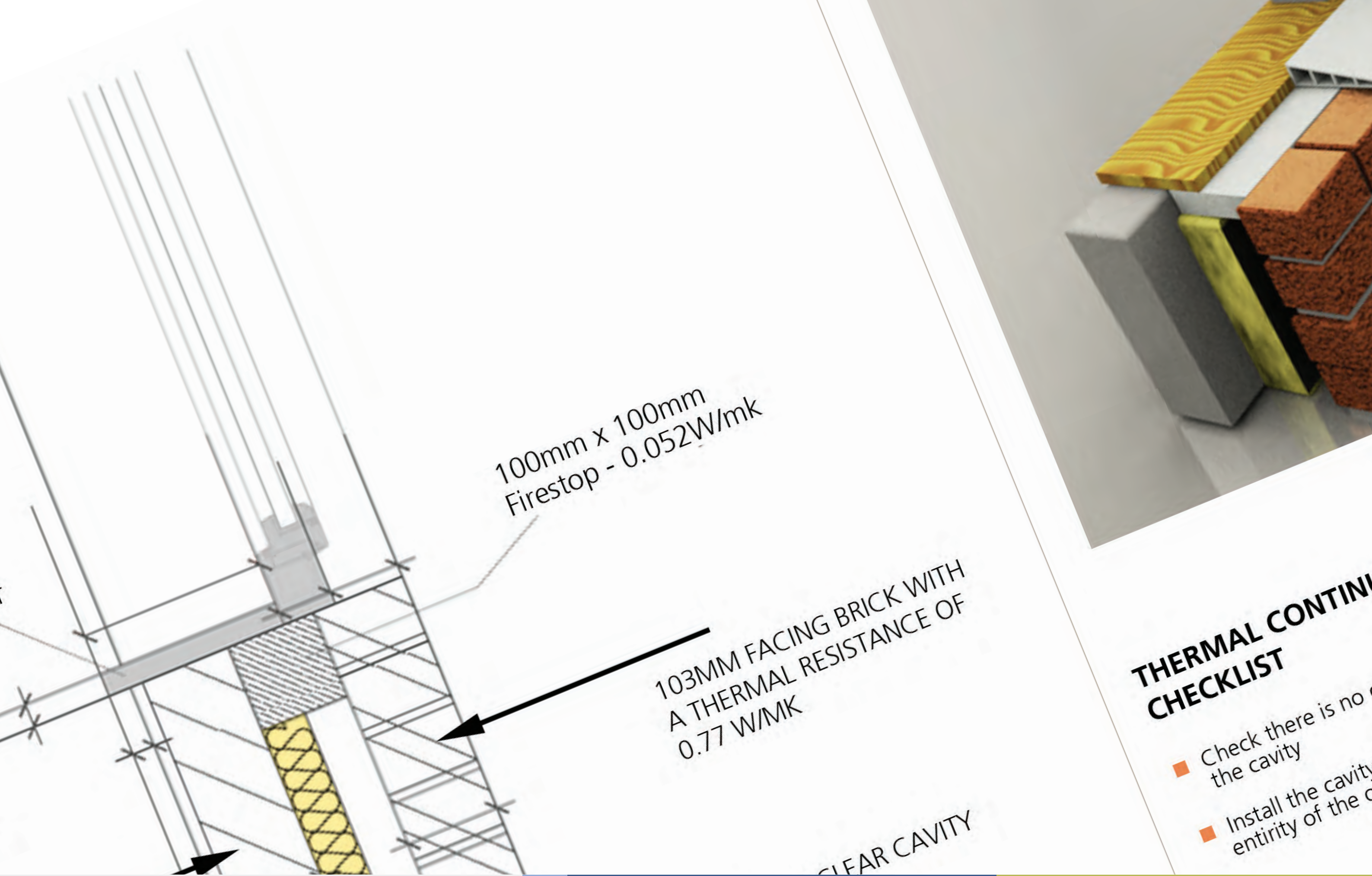

AIR BARRIER DESIGN PRINCIPLES

AN OVERVIEW

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AIR BARRIER DESIGN PRINCIPLES

Building Regulations Approved Document Parts L1A & L2A currently requires that new buildings have to achieve a level of air tightness such that when the building is subjected to a differential pressure of 50 Pascals (inside to out), it should not leak air through its envelope (in either direction) at a rate of more than 10 m^3 of air, per m2 of envelope per hour.

To achieve any reasonable level of air tightness, the building design needs to incorporate an 'air barrier', which in essence is a continuous layer of materials, components and elements that are sealed together to form a complete and impermeable 'shell' within the envelope. It will typically comprise dry lining, windows, external doors, roof liners, the ground floor slab, and all the sealing materials that join them together.

Ideally, the air barrier should be positioned on the warm side of the insulation (e.g. the internal finishes of external walls) so as to prevent leakage into external wall cavities, as well as to enable remedial works to be carried out easily where necessary.

In principle, the air barrier should be designed to be:-

- Continuous: Having no gaps or holes in it to allow leakage to occur.
- Robust: Being capable of maintaining performance over the design life.
- Build-able: Such that the design principle can be translated into reality on site and that remedial works can be carried, if required, towards the end of the programme.

Careful consideration must be given to choice of materials: e.g. course block, mineral wool and other fibrous materials or boards are generally not air-tight.

Where buildings have a cold, ventilated roof design, there will need to be an impermeable air barrier positioned below it, to prevent any leakage into the roof void. Likewise, plant rooms, lift shafts and cold storage rooms are generally ventilated to atmosphere, such they are outside the 'conditioned space'.

Therefore, the air barrier needs to be designed to prevent leakage into these areas, by being positioned on the warm side of all separating walls and floors between these spaces and adjacent conditioned spaces. Any penetrations for services into these areas need to be robustly sealed.

"Furthermore, a lower air-leakage rate (referred to as Design Air-Permeability Rate), may be stipulated as part of the overall strategy to ensure that calculated CO_2 emissions rates do not exceed the required limits (as calculated by SAP/SBEM)."

On top of this, it is increasingly the case that Clients stipulate lower air-permeability rates, over and above what would be required to satisfy Part L1A/L2A

Other considerations include 'inter-connecting cavities', i.e. internal walls built into external walls such that there is a potential air leakage path from the cavity of the former into the latter. In these cases, the internal walls will also need to have their cavities sealed.

Where structural steelwork has been encased in fire-board, a similar inter-connecting cavity problem can occur, as a result of air getting into the voids within inner beam encasements and transferring into/out of perimeter beam encasements, which in turn may lead to the main external wall cavities. Similarly, it is wise to close off the ends of concrete hollow planks, so that they cannot become an air path via any unsealed service penetrations to the external wall cavity.

A critical area is in the eaves of the building. Care should be taken to design and build out any opportunity for air to leak into cavities via steelwork junctions, unsealed roof liner corrugations, unsealed boxed column heads, penetrations through bulkheads, etc. It is not wise to leave overhanging eaves or canopies open from the inside, lest the cladding system, from which they are typically constructed, is not airtight.

Similarly, particular care should be taken where the design incorporates perforated roof-liners (are they sealed at the edges?), curtain wall systems (edge sealing details) and complex clad roof designs involving numerous cuts and changes in direction, plane or height.

As tiled suspended ceilings or raised access floors are not normally air-tight in themselves, then the voids above or below them respectively cannot be excluded from the air-sealing strategy.

Furthermore, it is important to ensure that any necessary air-sealing work needed in areas that will later become part of a void above a solid ceiling, needs to be completed before the solid ceiling is installed. Otherwise, the void might act as a leakage path, which is difficult to rectify once the solid ceiling is in situ.

Cavity walls should be sealed such that air-cannot exchange between the cavity and the conditioned space. In view of this, any cavity walls that come into the conditioned space (i.e. conditioned air is on both sides of the cavity walls, then these needs to be sealed on both sides. Where cavity walls are supported on twin-beams, the gap between the beams needs to be sealed, again to stop air transfer to/from the cavity.

The performance of proprietary envelope items, such as external doors (especially revolving and sliding doors), windows, window trickle vents, curtain walling systems, skylights, etc, will have an influence on the eventual test result. Therefore, the suppliers of these products, and their installers, should be challenged on the air-tightness performance of their products.

There is arguably equal onus on the designers and the builders to achieve the right level of air-tightness. While designers need to incorporate an effective, buildable and rectifiable air barrier, the builders need to ensure that they and their sub-contractors adhere to the design requirements and apply sealing where necessary.

TYPICAL AIR LEAKAGE PATHS

These are general recommended approaches, that may to a lesser or greater extent apply to your specific project. For more specific design advice with a more detailed report, we would recommend that you engage Stroma to conduct a Design Workshop.

WALL CONSTRUCTION

DRY LINING
Probably the most common barrier layer for commercial developments, if adopted as the designated barrier the dry lining should be sealed at both top and bottom to the floor slab and roof or ceiling construction. Ensure that the external dry lined walls are completed and sealed prior to constructing the internal stud partitions from them. However, where applicable care should be taken to ensure that acoustic properties are maintained in accordance with Part E of the Building regulations. Ensure service outlets such-as sockets or data outlets in the dry lining are well sealed.

BLOCKWORK:
Plaster does not leak, however unfinished block work leaks at varying rates from 0.1 to 60 $^3/(hr.m^2)$, consequently careful choice of blocks should be made. Ensure all structural movement joints are suitably sealed. Additionally the standard of mortar joints has a major impact of the permeability rate of the material, therefore ensure all joints are fully pointed.

SHEET METAL CLADDING:
This commonly adopted construction material is usually adopted for warehouse and retail Units. However it can be problematic as the designated air barrier. The actual cladding panels are inherently air tight but careful considerations must be made in order to ensure that all junctions are adequately air sealed.

PROPRIETARY CURTAIN WALLING SYSTEMS:
Curtain walling systems are usually well designed and installed with gasket joints between panels and the frame construction. Junctions between the curtain walling and other adjacent dissimilar construction types need to be addressed to ensure continuity of the air barrier. Particularly where the curtain walling is built over multiple floors such that floor voids may be left open to the adjacent exposed cavity walls.

WINDOWS AND DOOR FRAMES:
Care to be taken that all jambs, cills and heads are sealed at the cavity and the inside surfaces of plaster are sealed, in order to ensure continuity of the specified air barrier to the inside face of the wall construction and not simply the external face of the building.

STEELWORK:
Ensure all steelwork penetrations are sealed correctly, i.e. were they pass through ventilated ground floor slabs and/or the designed air barrier. A commonly observed problem area is found at the various intersections between the steel frame and blockwork infill panels. All these junctions must be adequately sealed if the inner leaf blockwork is the designated air barrier.

If the steel frame is to be boxed out with plasterboard (or similar material) and this boxing is adopted as part of the air barrier, care must be taken to ensure full continuity of the air barrier. For example the boxing must be capped at ceiling level or be fully continuous to the structural floor above and below. Care must also be taken to prevent cavities interlinking by means of the steel encasement, and therefore causing leakage internally to the perimeter walls.

FLOOR CONSTRUCTION

PRECAST HOLLOW CONCRETE PLANKS:
The hollow concrete plank construction can allow air to traverse horizontally within the floor construction into the external cavity construction, if the holes are not sealed.

SOLID POURED CONCRETE SLABS:
Solid concrete floor constructions are inherently air tight, as such they are ideal as a specified air barrier, however all penetrations such as services should be fully sealed with appropriate materials.

ROOF CONSTRUCTION

PROFILED METAL DECKING:
The underside surface of the decking is the airtight barrier and this should be sealed to all the adjoining structures and the sheets should be sealed to each other during the construction of the roof. Appropriate profile fillers must be adopted for all the eaves junctions, often the structural steel work supports can obstruct access to sealing of the cladding care must be taken to ensure these areas are appropriately sealed.

Use of the vapour barrier as the airtight layer should be avoided since this is often not an effective airtight seal, which can not be remedied at a later stage without incurring significant cost. With this in mind, careful consideration must be paid to all air sealing details associated to perforated acoustic lined roof constructions.

FLAT ROOFS:
These types of roof usually provide a good airtight barrier over the main horizontal area of the roof since they are designed to prevent water ingress. The airtight barrier still needs to be carefully defined and may not be the waterproof membrane.
Care should be taken around parapet flashing details and roof penetrations above the top of the tanking as watertight details may not be airtight and may not perform well to prevent air leakage.

CEILING CONSTRUCTION:
Suspended ceiling tiles do not form a suitable air barrier, as they are not considered to be robust, consequently they should be disregarded when specifying the air barrier. Solid ceiling such as plasterboard are more appropriate, however these types of ceiling limit future access to the zone above the ceiling.

It is essential to ensure that the ceiling air barrier is consistent and continuous. Alternatively transitions between any areas of a building that have both solid ceilings and false ceiling tiles can be considered such that solid bulk head should be constructed to ensure air may not flank behind the solid ceiling from adjacent false ceiling areas.

GENERAL DETAILS

LIFT SHAFT DOORS:
Lift shafts usually have a permanent external vent such that they should be considered as external unconditioned space; as such the head of the lift shaft should be fully sealed. Lift shaft doors should have an effective door seal; there should also be an appropriate seal beneath the raised floor as appropriate.

LOADING BAY DOORS:
Concertina type sliding doors are often particularly difficult to seal at the head & foot. Sectional panel type doors with tapered runners should be specified where possible.

MECHANICAL & ELECTRICAL SYSTEMS/ PLANT ROOMS:
All plant rooms should be considered as unconditioned space as such they are outside the defined air barrier.
Consequently care should be taken to ensure correct location of the air barrier around the partition walls separating plant rooms from the remaining conditioned space of the building, along with appropriate sealing of all penetrations to the plant rooms.

CONTACTS

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